



Porosity in Chalk

Fabricius, Ida Lykke

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Porosity in chalk

Ida Lykke Fabricius

Technical University of Denmark, Department of Civil Engineering, Section for Geotechnics and Geology, DTU Brovej, bygning 118, DK-2800 Kongens Lyngby, Denmark

e-mail: ilfa@byg.dtu.dk

Typical chalks from a North Sea Upper Cretaceous or lower Paleogene petroleum reservoir have depositional texture in the range from mudstone to wackestone, only sporadically packstone. The grains of the wackestones and packstones are typically 0.5 to 5 millimeter in size and can be microfossils, fossil debris and intraclasts. The calcitic mud particles are sometimes visibly biogenic, but in many cases recrystallized. They are typically 1 to 5 micrometer in size. In the pore space among these calcitic components, the chalk can contain diagenetically formed clay minerals and silica, both below 0.5 micrometer in size. The particle size distribution in chalk can be rather complicated caused by the mixing at two levels, but from a pore point of view, most chalks have rather narrowly defined pore size distributions with only minor contributions from larger intrafossil pores. Petrographic data, Nuclear Magnetic Resonance data, Mercury Injection Capillary Pressure data, He-porosimetry data and specific surface by Nitrogen adsorption data in combination indicate that on a centimeter scale, chalk pore space is homogeneous and well connected with no pore-throat effects. Permeability is in most cases around 1 milliDarcy and fall in the range 0.01 to 10 milliDarcy. Would we consider such a system microporous?

The diagenetic porosity development of chalk can be inferred, because these pelagic sediments are found in thick sequences on oceanic plateaus, where deposition has occurred continuously from the Cretaceous to Present. In the uppermost 200–300 meter below sea floor we find carbonate ooze, where porosity gradually decreases from around 70% to around 50% due to the load of the sediments, although the particles are in very poor contact in this interval. One reason for this is that the particles repel each other due to adsorbed ions. In order to overcome electrical repulsion a high contact load is required, so when the ooze indurates into chalk, the ooze particles are consequently subjected to an elastic strain of up to 0.5%. This is enough for calcite-contact pressure dissolution to take place and the early pore-stiffening cementation is found. This process leads elastic strain to drop drastically and the porosity remains close to 50% for the next up to 500 meter of burial. Before this depth, clays have dissolved and re-precipitated as stylolite-precursors and elastic strain has built up again to 0.3%. This is enough for pressure dissolution at stylolites which leads to porefilling cementation and marked decrease in porosity.